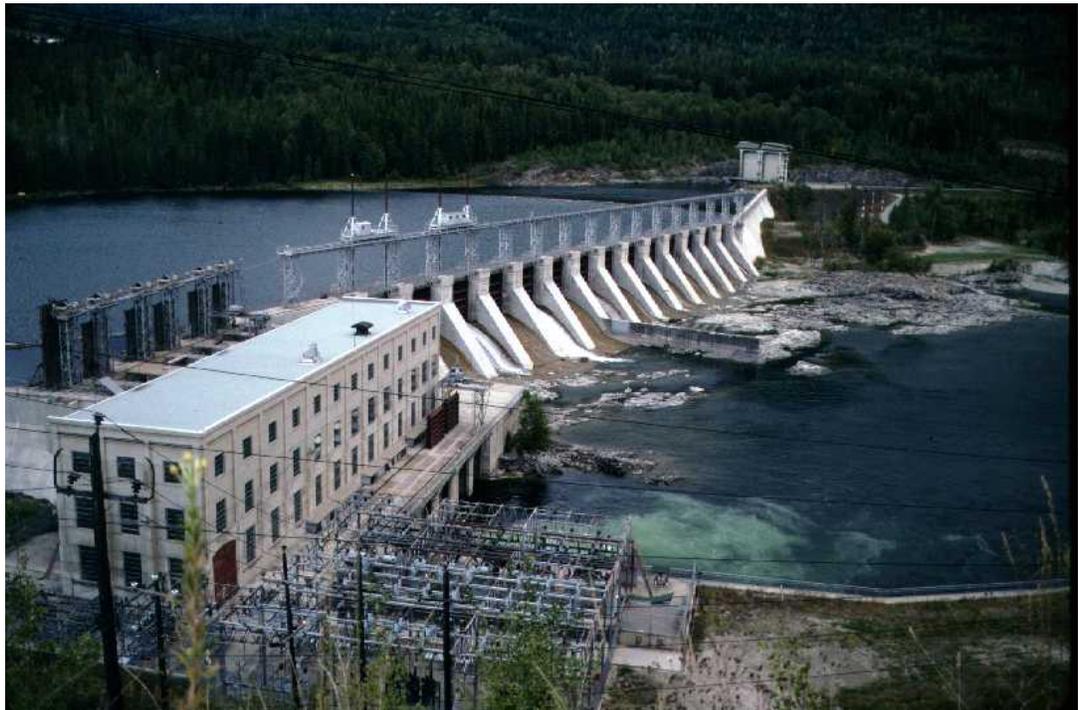




International Kootenay Lake Board of Control

2018 Annual Report to the International Joint Commission

This Annual Report covers the operations of Corra Linn Dam by the Applicant to the IJC Order (FortisBC) and the associated effects on the water level of Kootenay Lake in 2018. FortisBC operates Corra Linn Dam on the Kootenay River, approximately 22 kilometers upstream from its confluence with the Columbia River, and downstream from the West Arm of Kootenay Lake. FortisBC controls discharge through and around Corra Linn Dam in accordance with requirements of the Order of the International Joint Commission dated November 11, 1938. FortisBC co-operates with BC Hydro, which also manages a hydro-electric generating facility (the Kootenay Canal Project) which is hydraulically connected to the Corra Linn dam forebay on the Kootenay River through a constructed canal.



Corra Linn Dam

Kootenay Lake 2018 Summary

Throughout 2018, FortisBC operated Corra Linn Dam in a manner consistent with that prescribed by the 1938 Kootenay Lake Order.

The minimum instantaneous water level was observed at 02:05:00 PDT on April 14th, 2018, at elevation 530.079 metres¹ (1739.10 feet). Due to high lake inflow beyond the control of the Applicant, the lake level exceeded the IJC rule curve during the winter-spring drawdown period on March 17th, 2018, and the lake level did not reach the low elevation target of 530.145 metres (1739.32 feet) by the date required in the order (on or around April 1st). However, the Board determined that there was no violation of the IJC Order for Kootenay Lake because the Applicant responded by taking appropriate action of maintaining maximum flow through the natural flow constriction at Grohman Narrows, upstream of Corra Linn Dam. The lake elevation did eventually reach the low elevation goal of 530.145 metres (1739.32 feet) on April 10th, prior to the commencement of spring rise. The lake once again exceeded the IJC rule curve on April 17th, 2018, due to high inflows. This exceedance was also determined by the Board to be in compliance with the IJC Order, as the Applicant again maintained maximum flow through Grohman Narrows.

The Board determined the date of the commencement of the spring rise as April 25th, 2018. The maximum instantaneous water level for the lake at Queens Bay was subsequently observed on 12:15:00 PST on May 27th at elevation 534.079 metres (1752.23 feet). Kootenay Lake discharged 24.1 cubic kilometres (19.5 million acre-feet) of water in 2018, with an average flow of 765 cubic metres per second (27,000 cubic feet per second).

Board Membership

In 2018, there were no changes to the Board memberships; however, Canadian Section Secretary Gwyn Graham (Environment and Climate Change Canada), was replaced by Martin Suchy (Environment and Climate Change Canada) on October 1st, 2018. The Board members at the end of 2018 were as follows:

For the United States:

Colonel Mark Geraldi, District Engineer, Seattle District
United States Army Corps of Engineers, Seattle, Washington

Dr. Kyle Blasch, Director, Idaho Water Science Center
United States Geological Survey, Boise, Idaho

For Canada:

Mr. Bruno Tassone, Manager (retired), Water Survey of Canada
Environment and Climate Change Canada, Vancouver, British Columbia

Mr. Ted White, Director, Water Management Branch
BC Ministry of Natural Resource Operations, Victoria, British Columbia

¹ All elevations are referred to G.S.C. 1928 datum.

Board Secretariat:

Mr. Kevin Shaffer (United States Army Corps of Engineers)
Mr. Martin Suchy (Environment and Climate Change Canada)

1938 Kootenay Lake Order Sections 2(4) 2(5) and 2(6)

2(4) ...the Applicant shall be permitted to store water in the main body of Kootenay Lake to a maximum elevation of 1745.32, Geodetic Survey of Canada datum, 1928 adjustment (i.e. six feet above zero of the Nelson gauge), in accordance with the rule curve detailed in Sub-section (5).

(5) That after the high water of the spring and early summer flood and when the lake level at Nelson on its falling stage recedes to elevation 1743.32, Geodetic Survey of Canada datum, 1928 adjustment, the gates of the dam may be so operated as to retain it at said level until August 31st, and after said date, the level of the main body of the lake may be raised to elevation 1745.32, which shall be the maximum storage level until January 7, and thereafter it shall be lowered so that it shall not exceed elevation 1744 on February 1, elevation 1742.4 on March 1, and elevation 1739.32 (i.e. zero of the Nelson gauge) on or about April 1, except under extraordinary natural high inflow conditions, when sufficient gates shall be opened and remain open throughout such period of excess so as to lower the level of the main body of Kootenay Lake to the storage level at that time obtaining as above defined.

(6) ...throughout the period of flood flow in each and every year, (i.e. from the commencement of the spring rise in March or April until the level of the lake at Nelson returns to elevation 1743.32, Geodetic Survey of Canada, 1928 adjustment, on the falling stage), a sufficient number of gates and sluiceways of the dam shall be opened to provide, in conjunction with the flow through the turbines, for the lowering of the main body of Kootenay Lake ... by at least the amounts ... as follows:

Discharge from Kootenay Lake under original conditions (in second feet) [vs.]	Amount of lowering to be affected on the main body of Kootenay Lake (in feet)
10,000	1.0
25,000	1.3
50,000	1.7
75,000	2.1
100,000	2.6
125,000	3.0
150,000	3.2
175,000	3.5
200,000	3.8
225,000	4.0

Lake Regulation

Figure 1 presents observed calendar-year 2018 water levels on Kootenay Lake and the elevations specified in the November 11, 1938 IJC Order. Water levels on Kootenay Lake showed a distinct freshet peak in 2018, corresponding to increased inflows from snow-melt in this mountainous watershed. Water levels on Kootenay Lake were drawn down in accordance with the IJC rule

curve, beginning in January. The lake draft occasionally reversed and stalled during the winter-spring drawdown period, primarily due to increased outflow from upstream storage reservoirs in the basin. Sustained rising inflow from snowmelt began in late-April and peaked in mid-May. The Board determined the commencement of the spring rise to be 13:00 PDT on April 25, 2018, the point at which the IJC rule curve switches from maximum lake elevation criteria to the lowering formula as stipulated in the IJC Order. The spring rise was declared based on sustained increases in unregulated stream hydrographs throughout the Kootenay River Basin, in response to snowmelt. The Applicant maintained the maximum outflow through Grohman Narrows for the duration of the high water period. The lake drafted below elevation 531.364 metres (1,743.32 feet) at Nelson on July 11th, 2018, triggering the end of the high water period. Corra Linn Dam operations maintained fairly stable water levels on Kootenay Lake through the end of August, drafting slightly in September, and at similar levels through most of the fall storage period. Water levels were raised towards the storage maximum by late-December.

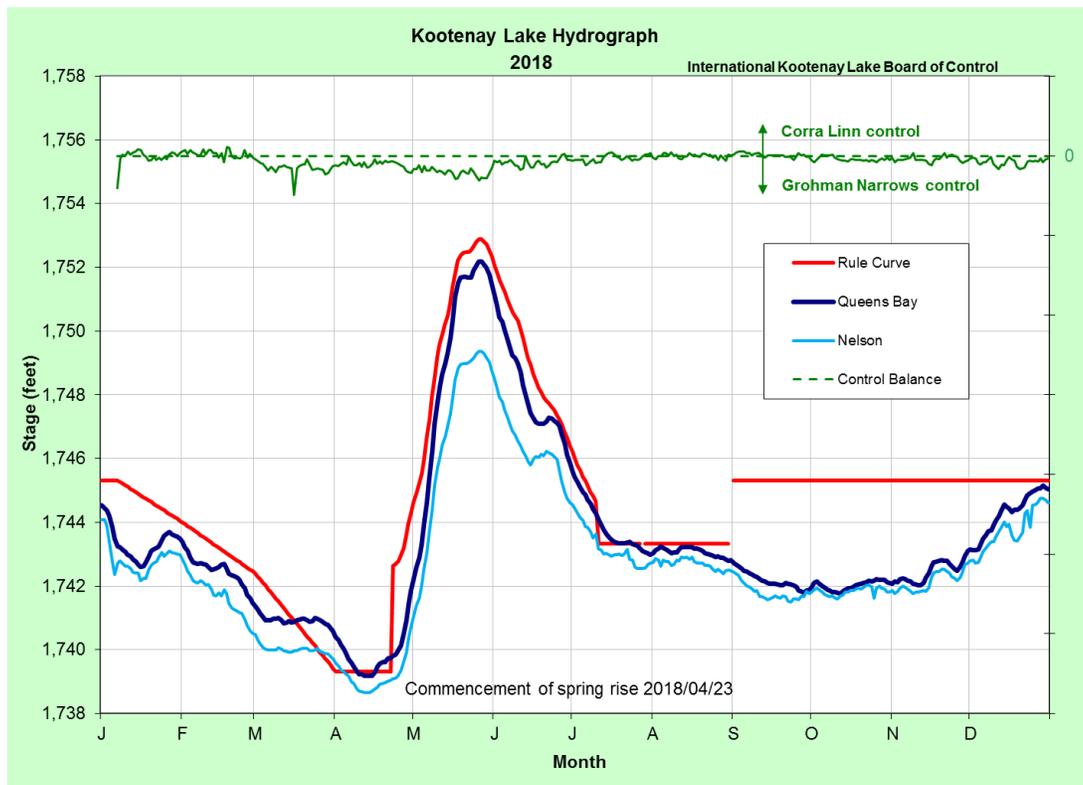


Figure 1 – Kootenay Lake Hydrograph

The maximum instantaneous water level of 534.079 metres (1752.23 feet) for the lake at Queens Bay was reached on May 27th, 2018, from 12:15 to 12:20 PST. The minimum instantaneous water level, elevation 530.082 metres (1739.11 feet), was observed five times between 6:10 and 18:20 PST on April 14th. Relative to the 88-year period of record (1931 to 2018, with two years missing; 1934 and 1947), this year's maximum water level ranked 45th highest, and the minimum was the 26th lowest annual minimum. Over the period of record, water levels in the lake have ranged from a high of 537.04 metres (1761.95 feet) in 1961 to a low of 529.56 metres (1737.41 feet) in 1944.

Kootenay Lake discharged 24.1 cubic kilometres (19.5 million acre-feet) of water this year through Corra Linn Dam and the Kootenay Canal Plant, with an average flow of 765 m³/s (27,000 cfs). Relative to the 81 years of available

discharge data, the annual volume of flow out of the lake was 41st highest over this period of record. Total lake outflow has ranged from a high of 33.8 km³ (27.4 million acre-feet) in 1954 to a low of 13.8 km³ (11.2 million acre-feet) in 1944. The maximum daily mean outflow was 2,452 m³/s (86,600 cfs) on May 27th, 2018. The minimum daily mean outflow of 156 m³/s (5,500 cfs) was observed on October 14th, 2018.

FortisBC has continued to supply the Board with complete records of the regulation of Kootenay Lake as affected by the operations of Corra Linn Dam and the Kootenay Canal Plant.

Compliance Summary

As shown in Figure 1, the lake level elevation did not reach the low level target of 530.145 metres (1739.32 feet) on or about April 1 (section 2(5) of the IJC Order), due to high inflows beginning early-March that exceeded the maximum lake discharge capacity. The Board confirmed that the Applicant was operating Corra Linn Dam in free-fall mode during this time and that Kootenay Lake outflow capacity was constrained by the natural channel constriction at Grohman Narrows (upstream of Corra Linn Dam) and not by the dam itself. Based on this information, the Board confirmed that operation of Corra Linn dam was in compliance with the IJC Order. The lake levels again exceeded the IJC rule curve before the commencement of spring rise in mid-April. The Board again confirmed that the Applicant was maintaining maximum outflow through Grohman Narrows and was in compliance with the IJC Order. At all other times in 2018, the Applicant maintained the lake below the IJC rule curve.

Applicant's Payment to Farmers in the Kootenai Valley (Idaho)

According to the 1938 Order, FortisBC must pay farmers on the Kootenai Flats in Idaho up to \$3,000.00 (U.S) for additional pumping costs related to dyke seepage from higher water levels during storage periods. FortisBC has a separate agreement with the Kootenai Valley Reclamation Association for an additional pumping cost payment based on actual receipts. Payments have not yet been issued to Idaho for pumping costs in 2018, but will likely be within the range of the 2017 payment amount of approximately \$28,000 (USD).

Board Meetings

The Board toured Libby Dam near Libby, Montana, and held its annual and public meetings in Bonners Ferry, Idaho, on September 20, 2018.

Board Tour

Board members visited the United States Army Corps of Engineers' (USACE) Libby Dam in Montana. The Board attended presentations on Libby Dam operations and water management, followed by a tour of the dam.

Libby Dam is located on the Kootenai River in Montana, upstream of Kootenay Lake. The dam was authorized by the U.S. Flood Control Act of 1950 and the Columbia River Treaty. Construction occurred between 1966 and 1972. The dam impounds Lake Koocanusa, the seventh largest reservoir in the United

States, which extends upstream into Canada. The dam is operated for flood risk management on the Kootenai River in and around Bonners Ferry, Idaho; flood risk management in the greater Columbia River basin; hydropower generation; and fisheries objectives. Construction of the dam resulted in significant reductions from historical peak flows and lake levels on Kootenay Lake.

Libby Dam, similar to Duncan Dam in Canada, is no longer operated to specifically meet the Kootenay Lake rule curve and the Kootenay Lake Orders of Approval. However, water management operations at Libby Dam and on Lake Kooconusa are coordinated between Canada and the United States through the Columbia River Treaty framework.



Clockwise from Top Left: Libby Dam, Downstream of Libby Dam, Inside the Treaty Tower, Treaty Tower. Photos: September 20, 2018 (Wayne Jenkinson, IJC Engineering Advisor – Canadian Section)

Annual Board Meeting

The annual board meeting was held on the afternoon of September 20th in Bonners Ferry, Idaho.

The Board reviewed action items from the past meeting. The Board had previously been notified by local farmers in Idaho that moderate Kootenai River levels were resulting in crop damages. Specifically, damage was noted when the gage elevation at Porthill, Idaho, exceeded 1,750 feet. Kevin Shaffer, U.S. Secretary, followed up with the hop farmer (Mr. Ed Atkins) to obtain clarification of under which conditions crop damage was occurring, since elevation 1,750 feet is regularly reached at Porthill and significant damages were not commonly reported. Mr. Atkins confirmed ponding in fields and crop damage occurs at these levels but indicated that the significant crop damage occurs only during when the river is above these levels for prolonged periods of time, or during particularly high levels.

The Board reviewed the Applicant compliance of the IJC Order and basin hydrology for 2018. FortisBC met Order requirements, despite a rule curve exceedance due to high lake inflows in mid-March. The Board determined that this was not a violation of the Orders since Corra Linn Dam was in freefall during this time. Water year 2018 was a wet year with significant snowmelt runoff. The significant snowpack led to flooding concerns in the Kootenay Lake basin. The unusually dry spring and summer helped avert major flooding in the basin. The maximum lake elevation in 2018 was the third highest since the construction of Libby Dam. The peak inflow into Kootenay Lake in mid-May was the fourth highest inflow since the construction of Libby Dam.

Dale Ernst (FortisBC) provided a presentation by the Applicant, reviewing Kootenay Lake levels in 2018 to date, Corra Linn operations and planned upgrades at the dam. Mr. Ernst indicated that Kootenay Lake drawdown followed the rule curve until mid-March. The lake levels exceeded the rule curve but eventually met the minimum required elevation in mid-April. FortisBC and BCHydro utilized Corra Linn Dam and the Kootenay Canal to keep the river on freefall through Grohman Narrows beginning March 1st, 2018. When freefall operations occur, the maximum possible outflow is released from the lake and Corra Linn Dam is not operating to a specified lake elevation. Fortis BC launched a communication campaign in 2018 out of concern for the lake reaching elevation 1,754 feet. 2018 was the third high-flow and high-lake year since 2012. However, public comments and concerns were unremarkable. Mr. Ernst speculated that the public may have become acclimated to higher water levels after the extreme 2012 event. Mr. Ernst updated the Board on progress of upgrades to Corra Linn Dam. Mr. Ernst indicated that HMI Canada had been awarded the contract to upgrade the spill gates. Work includes pier-nose remediation work, remote gate operator (RGO) installation with structural steel reinforcement, electrical preparatory work, and superstructure structural steel reinforcement. Gate replacement is scheduled to start in September 2019.

Gillian Kong (BCHydro) presented an overview of BC Hydro Columbia River system operations. The joint operation between Corra Linn Dam and the Kootenay Canal preferentially releases water through the Canal Plant up to the plant capacity and remaining flow is passed through Corra Linn Dam and other Kootenay River dams. Ms. Kong indicated that Kootenay Lake discharge was maximized during the freshet but was constrained by Grohman Narrows. Ms. Kong indicated that efforts to further dredge Grohman Narrows effort had minimal support from the public but that, with additional dredging, the increased capacity could be used to reduce peak lake levels.

The Board reviewed correspondence from 2018: a public enquiry regarding the Nelson gauge operations and an enquiry regarding a Board mandate related to the Balfour ferry terminal dredging.

Annual Public Meeting

The annual public meeting was held on the evening of September 20th in Bonners Ferry, Idaho. The meeting was attended by fourteen audience members, including four local attendees. The remaining audience members were guests and representatives of the International Joint Commission.

Colonel Geraldi, United States Co-Chair, described the International Joint Commission framework, responsibilities, and composition. He outlined the history of the Kootenay Lake Orders of Approval, referenced the geographic area of the Kootenay Basin, and described the duties of the Kootenay Board. Colonel Geraldi detailed the main provisions of the Orders, including the dredging of Grohman Narrows, the reduction of peak lake levels on Kootenay Lake, and the repayment of additional pumping costs to farmers in Idaho. Colonel Geraldi also described the limitations on lake level control due to the outflow constriction at Grohman Narrows.

Kevin Shaffer, U.S. Section Secretary, provided an overview of the International Joint Commission seasonal rule curve on Kootenay Lake and compliance with Order in 2018. Mr. Shaffer indicated that the Applicant was in full compliance with the order in 2018. Mr. Shaffer reviewed the weather and hydrology from for water year 2018. Mr. Shaffer reviewed the operations of Duncan Reservoir (Duncan Dam), Kooconusa Reservoir (Libby Dam), and Kootenay Lake (Corra Linn Dam and the Kootenay Canal).

The Board took questions from the audience, covering a wide range of public and Kootenay Lake stakeholder concerns and interests. These questions and the Board responses are summarized in the minutes of the public meeting, located on the Board's website.



Photograph of Kootenay River free-fall discharge through Corra Linn dam during the Spring high-water period (Photo: Fortis BC)